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SOME INFORMATION ON AUTOMATIC COUPLING OF MINE CARS

BY

L. C. ILSLEY AND E. J. GLEIM

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SOME INFORMATION ON AUTOMATIC COUPLING OF MINE CARS[1]

By L. C. Ilsley[2] AND E. J. Gleim[3]

INTRODUCTION

In the normal operation of mines, the aggregate effect of many seemingly minor operations may be very important as respects economy and safety. Among these operations is the method employed in coupling and uncoupling mine cars. For economic reasons the equipment in mines has not been protected as well as railroad equipment. It is pertinent that haulage accidents rank second in severity among mine accidents, and that manual coupling of cars has been one of the most frequent causes of such accidents. One study[4] revealed that coupling was responsible for about 20 percent of haulage accidents underground. A review of early conditions on steam railroads, which were responsible for the introduction of safer methods of coupling cars, indicates how conditions in mines might be improved.

THE STORY OF RAILROAD COUPLING

As any considerable improvement in mine-car coupling probably will follow lines somewhat similar to those that brought order out of chaos for the railroads, it seems appropriate to review briefly the steps taken to improve railroad coupling from the days of link and pin couplings of various types to the adoption of the standard "M.C.B." automatic coupler.

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7245."

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4/ Lutton, C. L., What Can Be Done to Reduce Haulage Accidents?: Min. Cong. Jour., vol., 27, 1941, p.17.

Hundreds of car couplers were patented, and the Master Car Builders of various railroads worked toward variation rather than standardization until coupling cars of various railroads became a serious meance to economy and safety.

The first step toward standardization of railroad coupling was to fix the height from the rail to the center line of the drawbar at 33 inches, a variation of 3 inches being allowed between loaded and empty cars.

It is reported that railroad managements furnished coupling sticks to guide the link in link coupling, so that the men's hands might be kept out of danger. They even provided a leather belt and a sheath in which to carry the stick. The sticks were used when the superintendent was present, but at all other times the men laid them away, considering such safeguarding a bother and a reflection on their ability.

In its report for 1890, the Interstate Commerce Commission declared that the most common cause of accidents on railroads was coupling and uncoupling cars, about a third of all accidents being attributed thereto.

The first so-called automatic coupler of practical design is thought to have been the invention of Ezra Miller, patented in 1863. The Miller safety platform with its coupler and buffer was considered one of the greatest of life-saving inventions. In a few years virtually all railroads except the Pennsylvania were using these couplers on passenger trains. Meanwhile, the Pennsylvania Railroad adopted a device patented by E. H. Janney in 1877. The Janney coupler is said to have been applied first to passenger cars on the Pittsburgh, Fort Wayne, and Chicago line of the Pennsylvania system. About 1878, McConwey and Torley purchased control of the patents and began to make Janney couplers.

The Janney coupler is the ancestor of automatic railroad couplers in use in the United States today. It was the first to apply the vertical-plane principle to its working parts. These parts were strongly yet simply constructed and operated reliably. The Janney was the first automatic coupler that would couple freight cars automatically and hold them so until released by a lever. A man could operate this lever without going between the cars.

Owing to the large number of types of couplers in use it seemed almost impossible to agree on one of them as a standard. The Master Car Builders finally arranged a systematic test of couplers in September 1885. Forty-six were entered, but only 42 qualified. As a result, 6 link couplers and 6 vertical-plane couplers were recommended for further study. In 1887, the Master Car Builders recommended adoption of the vertical-plane couplers. In 1888, they adopted a contour essentially like that of the Janney coupler. Under the Safety Appliance

Act of March 3, 1893, Congress passed a law making the use of the "M.C.B." coupler compulsory.

DEVELOPMENT OF AUTOMATIC COUPLERS FOR MINE CARS

In some respects the development of automatic couplers for mine cars seems to be another instance of "history repeating itself." Although railroads long ago discarded the link and pin coupler, it is still employed at many coal mines, and it was only within comparatively recent years that a concerted effort was made to introduce automatic couplers suitable for coal-mine service. As early as 1913, a three-quarters size "M.C.B." coupler was made for coal-mine cars, and in 1927 the Willison coupler was tried in coal mines; but wide variation in the height of cars and the gage of tracks and lack of car standardization in other respects no doubt greatly delayed general introduction of the automatic coupler. Mechanical loading, however, seems to have stimulated wider application; with the larger cars and faster handling necessitated by greater production, the advantages of automatic coupling become even more apparent. The cost of the coupler is no longer disproportionate to the total cost of the larger and costlier cars, nor is the space occupied by the coupler as vital a factor as it was with the less expensive smaller cars.

Early mine-car couplers had some disadvantages that were corrected in later designs. In one, the coupler shank was comparatively long and pivoted at the end, so that when it was coupled with another a long, rigid member was formed between cars. Differences between wheel and track gages allowed the center of the car to get out of alinement with the center of the track, so that when a heavily loaded trip of cars was stopped too quickly, the couplers produced a "jack-knife" effect that whipped cars off of the track. Hence, to avoid wrecks it became necessary in some instances to give motormen 2 or 3 weeks' special training in handling trips before they were permitted to take charge of regular hauls. In redesigning the couplers the side thrust, or cross component of decelerating force, was largely eliminated by making the point of application of the retarding force come at or near the car bumpers.

There appear to be differences of opinion as to the importance of self-centering as a feature of automatic couplers; when given the option, some mine operators select a coupler that is not self-centering. Undoubtedly, conditions in some mines such as short-radius curves, require a coupler that can be set at any angle with the track line. However, when it becomes necessary to use the hands and feet in alining a coupler its merit as a safety device is greatly reduced. Men have had their feet crushed while attempting to aline couplers, and further development may be required to produce a fully automatic coupler that will more nearly meet the safety requirements of all operators.

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PRESENT TYPES OF AUTOMATIC COUPLERS FOR MINE CARS

At least three manufacturers who have automatic mine-car couplers on the market offer a type suitable for cars unloaded in rotary dumps. Figure 1 shows a model for coal-mine cars made by one of these manufacturers. Two identical units, A and B, pivoted at a and b, are shown about to be coupled, the nose of each being alined for head-on entrance into a pocket of the other. Each unit carries a pivoted locking member normally held by a concealed spring in the position indicated, but, as coupling proceeds, these members push each other back into a recess in the coupler nose. When the couplers are fully engaged, the buffing faces are in contact, and in this position the locking members once more are made by their actuating springs to resume their normal positions. The ends of the locks overlap and are directly opposed to each other; that is, the center lines of the two locks coincide, and the interlocking of the couplers is completed.

Uncoupling is accomplished by pulling on either of the lock-releases. This draws the locking member within its recess, thereby disengaging the locks and allowing the couplers to separate. Chains attached to the release arms make it unnecessary to go between cars to uncouple them. The lock-release arms are so shaped that they are held against accidental release by vibration and also can be set to hold the locks recessed in the coupler noses to prevent the locks from engaging when coupling is not desired.

The shape and size of the coupler nose and openings permit coupling when alinement is not exact.

In this design, the heavy spring between plates e and f absorbs coupling shocks. The lighter spring next to plate f serves to keep the center line of the coupler head in line with the axis of the springs. When the coupler head is swung to one side, corner c or d strikes plate e and pulls on the rod within the springs. This puts the smaller spring under compression and thus tends to return the head to its straight-on position.

A model of a coupler made by another manufacturer is shown in figure 2. The units comprising this coupler are not identical but consist of a nose or head member, A, on one end of the car and a pocket member, B, at the other end pivoting about pins e and f, respectively. In the illustration, the nose, A, is about to enter the pocket, B. As coupling proceeds, the inclined face at the end of the nose strikes and lifts the lock in the pocket against spring tension. When coupling is completed, the lock has dropped into the notch in the nose, and the buffing faces of the two members are in contact.

To uncouple cars it is necessary only to raise the lock release, which in turn lifts the lock out of the notch: this allows the coupler members to separate. A chain attached to linkage makes it unnecessary to step between cars to uncouple them.

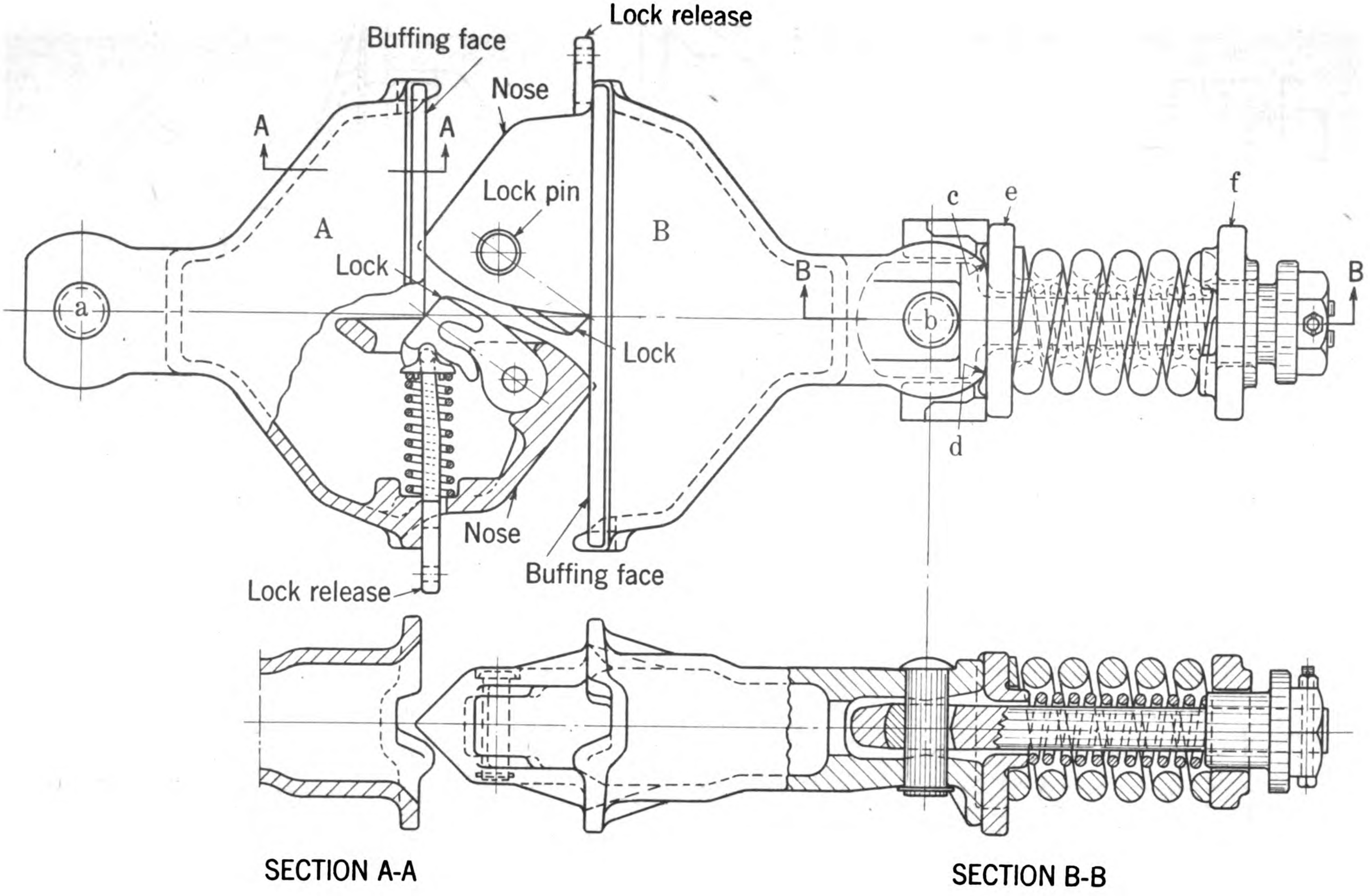

Figure 1.—Coupler made by manufacturer No. 1.

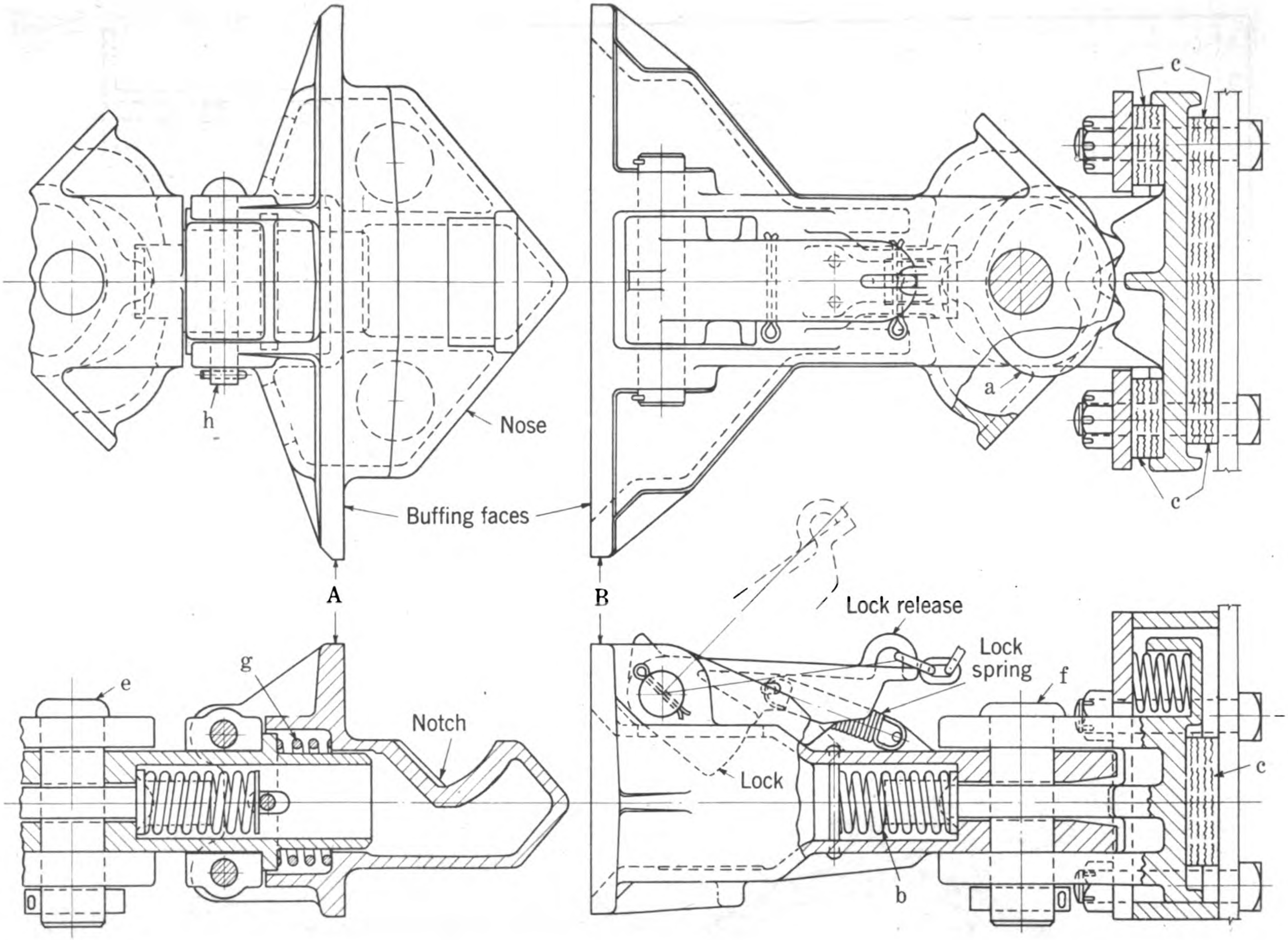

Figure 2.—Coupler made by manufacturer No. 2.

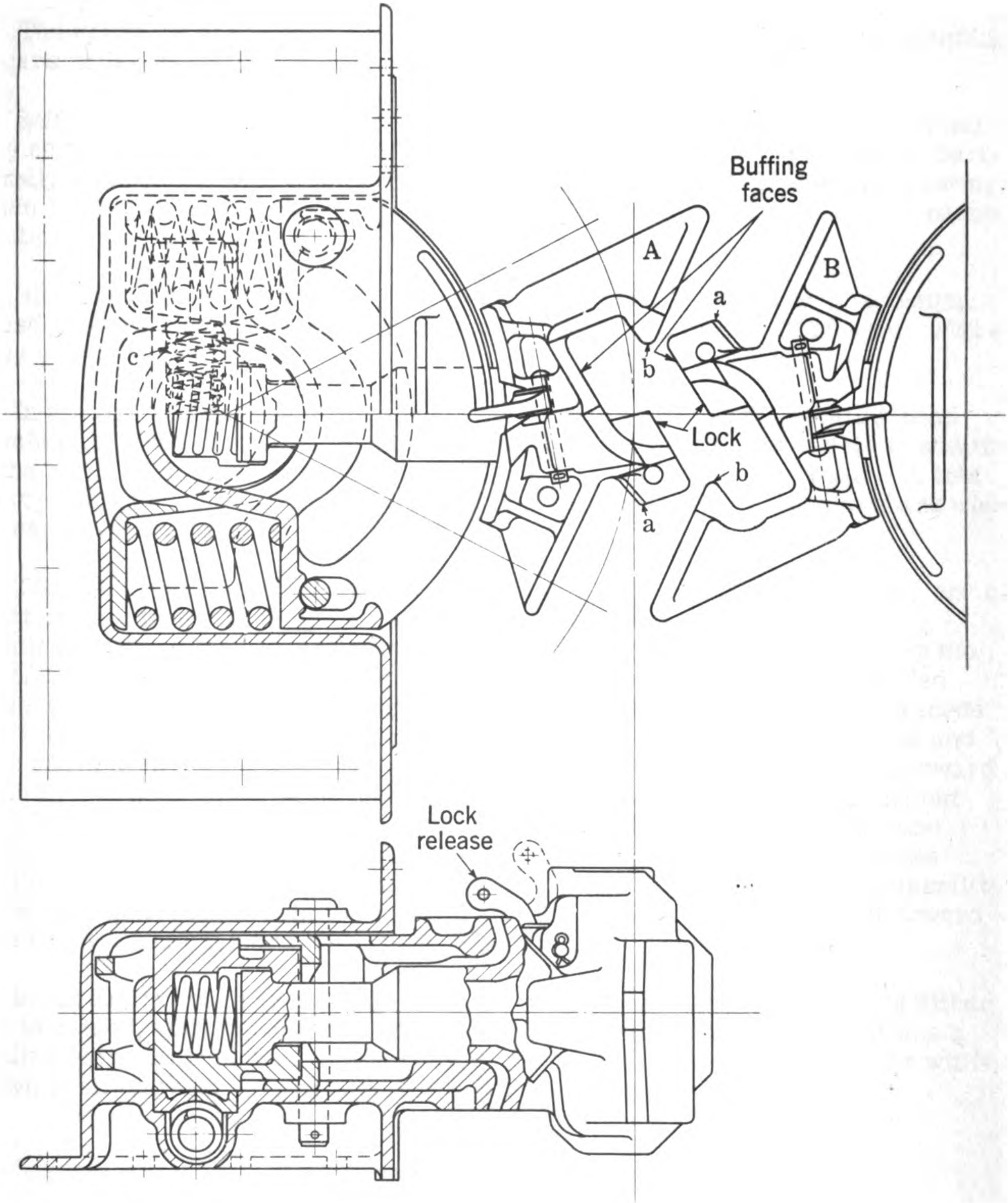

Figure 3.—Coupler made by manufacturer No. 3.

The contours of the nose and pocket are designed to facilitate ready coupling of cars under various conditions of imperfect alinement.

Self-alining of these coupler units is accomplished by means of the special ring casting a and the centering spring b. When the coupler unit is swung horizontally about its pivot, it causes the spring to be compressed by the ring casting, which is shaped so that the spring pressure on it tends to bring it back to normal position.

Blocks of rubber, c, to absorb coupling shocks are included in this design. These require much less space than is occupied by the spring-draft gear originally used.

In a more recent model, the manufacturer has modified the rotating head member A. This modification has eliminated coil spring g, and rivets in addition to the removable pins, h, are used in assembling the nose to the shank. A leaf spring has been added to keep the nose from rotating freely about the shank when the cars are not coupled.

The third manufacturer has a number of different models of couplers, one of which is illustrated in figure 3. This is a self-centering type in which two identical units, A, and B, are about to be coupled. Spring c serves to keep the couplers in line. Normally the lock members are held forward by concealed springs, but as coupling proceeds these members strike each other and recede into their respective sockets. This permits projections a to swing around and back of corners b, and when the locks clear each other they are pushed forward again by the springs. The projections a are thus prevented from slipping out from behind corners b. When cars are being pushed, the coupling units are forced against spring pressure to make contact with the curved faces of the housings in which the units are mounted. Thus the buffing forces are transmitted to the car front rather than to the pivot points, minimizing the tendency toward derailment when cars are being retarded.

In uncoupling cars employing this type of coupler, the lock release of either unit is raised, withdrawing the lock into its recess and allowing projections a to slide from behind corners b. A pin is provided to hold the locks in the withdrawn position when it is not desired to couple cars.

CONCLUSIONS

From the standpoint of safety, one of the main advantages of the automatic coupler lies in the fact that it is not necessary for haulage crews to reach or step between cars to couple or uncouple them. This, together with certain improvements in haulage conditions, makes the automatic coupler a very desirable feature of equipment for underground transportation by rail.

The ability of couplers to couple under various conditions in a mine depends largely upon the design of cars to be coupled. Consequently, radius of track curves and length and wheel base of cars and locomotives must be considered carefully in designing a coupler if its application is to be successful.

Reliable data showing how much the automatic coupler has reduced haulage accidents are difficult to obtain. Nevertheless, there can be little question that when chosen with due regard to the conditions to be met, the automatic coupler has contributed much toward safer operation of mines.